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SLEEP & WAKEUP TECHNIQUE BASED CLUSTERING PROTOCOL-PERFORMANCE EVALUATION IN WIRELESS SENSOR NETWORK

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ABSTRACT

In order to achieve data information, the Sensor Node's should form into small groups as clusters in wireless sensor network. In Multi-hop sensor network, the Base-Station (sink) is might not be considered. That is why, the hot-spot problem may occur in this network. In this paper, we analyze the sleep & wakeup approach, in order to avoid the hot spot (WLAN) problem, which aims to increase the network lifetime using energy conservation as well as increasing packet delivery ratio (PDR). In this technique, C-H (cluster-head) has been selected based on energy level & Base-Station distance. Using this technique, we can improve the energy conservation & PDR up to 63%, when compare to that of FCA (fuzzy clustering algorithm) according to their parameters of FND (First Node Dead) and HNA (Half of the Node Alive) parameter for each algorithm. Our simulation results shows that the sleep & wakeup approach is better and energy efficient clustering protocol based on their parameters.

Keywords: *WSN; clustering; FCA; Sleep & Wakeup Technique.*

1. INTRODUCTION

Wireless Sensor Network [1] performs "wireless communication" based on battery powered sensor nodes. The sensor nodes can sense the data information and send it to their base-station. After replacing (or) recharging the battery power level of each sensor nodes are not possible, when the battery power is low. The homogeneous and heterogeneous sensor nodes have chosen based on amount of energy level having same energy level; it is homogeneous, If not heterogeneous sensor node. WSN have used in many applications ex: Military applications for battlefield surveillance, Habitat monitoring, Disaster relief, Target tracking etc…

In WSN, each sensor nodes can aggregate all the clustering information known as data aggregation, which gives accurate results. Then they are partition in to small groups like clusters [2], [4]. Each cluster has a head known as C-H. Finally the packet transmission will taken place in between C-H as well as Base-Station. In this, each sensor node have a Digital Signature ID to send the data information to Base-Station in order to avoid the DoS attack, which means the sensor (source) node can send the data information with digital signature ID to Base-station. This can sense the information with digital signature ID, and then it can receive the data information. Figure 1 shows the WSN architecture.

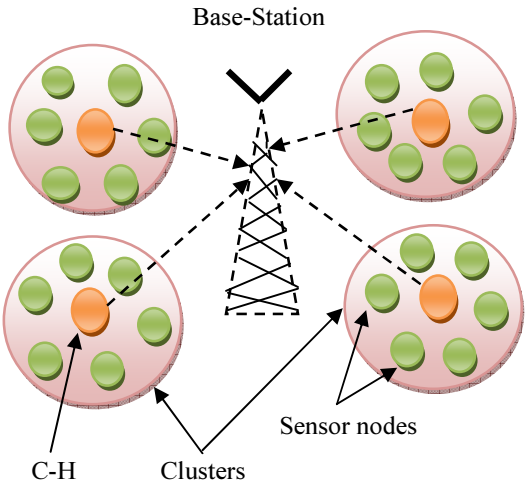

Figure 1: Wsn Architecture

In this paper, we compare and analyze the FCA and Sleep & Wakeup clustering protocols according to their parameters of FND and HNA. Here Sleep & Wakeup protocol is energy efficient and stable one compared to that of a FCA.

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Vaibhav Godbole [9] proposed this has protocol has used threshold value for selecting temporary C-H between 0's and 1's in competitive manner. From these temporary C-H's, Base-Station can select one static C-H based on their energy as well as Base-station distance. In Fuzzy Clustering Algorithm, fuzzy logic has used to avoid the uncertainties of C-H radius estimation.

In order to improve the energy saving and get a high packet delivery ratio (PDR), we use sleep & wakeup protocol [10] like as routing protocol. In this approach, the path has created in between C-H's as well as Base-station. If the sensor nodes are in path, then it becomes awaken nodes. Rests of the nodes are sleep nodes. Here, wake up node only can send their data information to base station according to the parameters.

2. RELATED WORK-CLUSTERING PROTOCOL

1 Fuzzy Clustering Algorithm

Fuzzy Clustering Algorithm [6] is a distributed competitive Algorithm. The temporary cluster-head's has been selected by using threshold value. In every round, the temporary C-H have selected by randomized rotation manner (number between 0&1). From these temporary C-H, the permanent C-H has been selected by using Mamdani method [7] of fuzzy inference technique have the fuzzy if-then rules with linguistic variables, which means based on the energy consumption and base-station distance the C-H has selected. Figure 2 shows the Fuzzy Clustering Algorithm design.

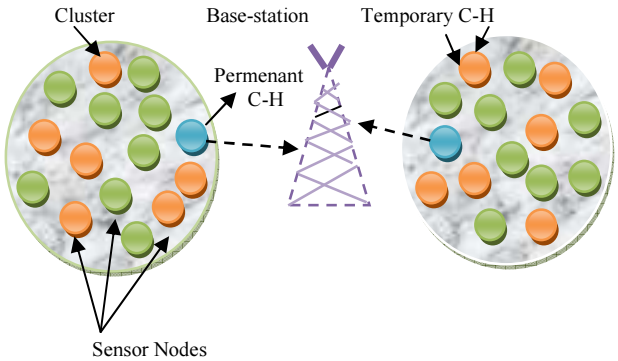

Figure 2: Fuzzy Clustering Algorithm

Fuzzy if-then Rules [8] as shown in table 1 was considered as the fuzzy descriptors, they are

(i) Node mobility
(ii) Base-station distance
(iii) Energy
(iv) The Centrality of Nodes.

TABLE 1: FUZZY IF-THEN RULES WITH LINGISTIC VARIABLES

Rule number	Fuzzy rank coefficient
1	High
2	High
3	Moderate
4	Low
5	Moderate
6	High
7	High
8	Low

The FCA uses A* Algorithm is used to sense the path and find its destination (Base-Station) as explained below. In fuzzy clustering algorithm, the Base-Station can select new accurate C-Hs based on the energy as well as C-H radius distance, for the reason that, the Base-Station has known about all the clustering information in a network as like Centralized Clustering Algorithm [9]. Followed by the data packet has been send from C-H to Base Station. Assume if any problem occurs in C-H radius estimation, then we must use the fuzzy logic condition in order to solve the problem, since fuzzy logic, put together a real time decisions in a complete network. Algorithm. 1 shows the Fuzzy Clustering Algorithm uses A* algorithm

Algorithm 1: The Fca Uses A Algorithm*

```
1.  function A* (start)
2.  set     clusters
3.  set     empty set     // for temporary C-H
    selection.
4.  set     T(n) ←μ(0,1)
5.  if THRESHOLD T(n) < Number
        be Temporary C-H ←TRUE
6.          if THRESHOLD T(n) > Number
                be Temporary C-H←FALSE
7.      end if
8.  end if
9.  apply fuzzy if- then rules = avoid
    uncertainties
10. Rcompetition & Energy ← for C-H selection
11. if sensor node ← high energy &< Rcomp

    distance.
12.     be static C-H ← TRUE
13.         else
14.             static C-H ← FALSE
15.     end if
16.  exit
```

of sensor nodes, because the Base-Station has accumulated the C-H in a network. Do again this processes the battery level gets discharge.

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(ii) Also in FCA, all the sensor nodes are in active sensor nodes. So it can spent more energy to propagate and send the data packet information to Base-Station.

2 Sleep and Wakeup Approach

In sleep and wakeup approach [12], aims to increase the WSN lifetime by using reducing the energy consumption as well as increasing the Packet Delivery Ratio (PDR). Yan Wu et al., [10] proposed this approach is routing algorithm. The C-H has selected based on energy efficiency [11] and base station distance, subsequently the data packet transmission will takes place. Figure 3 shows the Sleep & Wakeup Technique design.

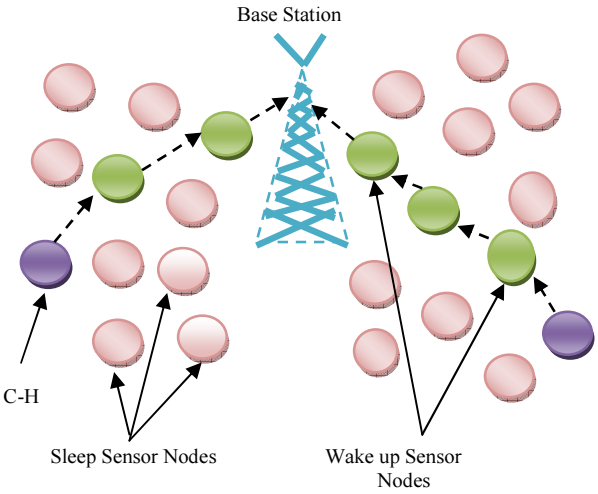


Figure 3: Sleep & Wake Up Approach

Algorithm 2, Sleep & Wakeup Approach [14] as explained below. Here the C-H has been selected as a mobile node. In mobility manner, the C-H can create a path to Base-station. Then the Base station can send the WORK_REQUEST message to C-H. If the sensor nodes are in the path, then the C-H can send the WORK message. Consequently, that particular sensor node becomes a wake up node [13]. After that the data packet transmission will taken place to base station. If the nodes are away from the path, then the C-H can send the sleep message. Subsequently, the sleep node does not send the data packet to base station.

After completing the data packet transmission, the sleep nodes preserve the WORK_REQUEST message to C-H, then the C-H can move from one place to another place, and then this process will repeated again, because of high-energy conservation. If any packet loss occurs, then the packet transmission will stop. Using this packet loss, we have to create a parameter of FND (first node dead) of HNA (half of the node alive) condition. Algorithm 2 shows the Sleep & Wakeup Technique algorithm.

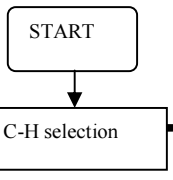
Algorithm 2: The Sleep & Wakeup Technique

·

1. Node state ← cluster member
2. $R_{competition}$ & Energy ← for C-H selection
3. if sensor node ← high energy &< R_{comp} distance.
4. be static C-H ← TRUE
5. else
6. static C-H ← FALSE
7. end if
8. path creation ← C-H to basestation
9. if Ready to wake up←sensor nodes
10. work_req msg ← send from C-H to sensor node
11. be wake up node = TRUE
12. sleep_msg ← send from C-H to rest of the nodes
13. be sleep node = TRUE
14. if completed packet transmission
15. Mobile C-H ← Repeats step 8
16. work_req ← send from sleep nodes to C-H
17. packet transmission ← from C-H to base station
18. end if
19. end if
20. exit

Figure 4 shows the flow chart for Sleep & Wakeup Approach. The flow chart shows," how the packet will be transmitted" and it becomes dead.

Flow chart:



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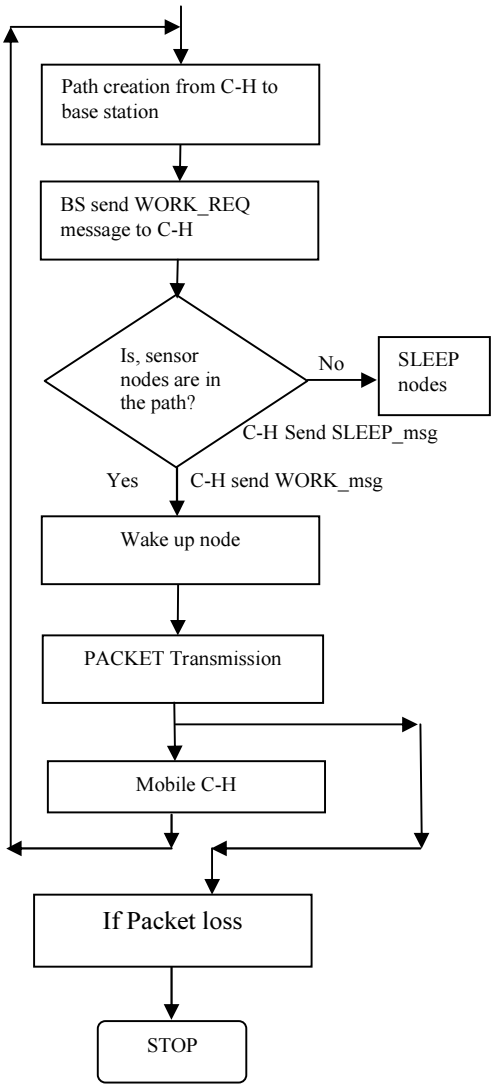

Figure 4: Flow Chart For Sleep & Wakeup Approach

3. SIMULATION RESULTS AND DISCUSSION

In simulation part we just compare and study the performance of the FCA with Sleep & Wake up Technique by using Network Simulator 2.32(NS2) [16] [17]. .Network simulator2 is a powerful tool and it is object oriented. The NAM area size is 200m x 200m. In this, Sleep & Wake up Technique makes a routing path to send the data packet information from source node to destination node. The table 2 represents the simulation parameters.

Table 2: Simulation Parameters

Simulation Parameters	Value
Network Area Size	200m x 200m
Initial energy	1J
Routing Protocol	AODV
Simulation Time	10 minutes
Traffic source	CBR
Data Packet Size	3000 Bytes
Number of Clusters	4

Senerio 1

In this scenario 1, the FCA and SLEEP & WAKEUP Technique for FND as well as HNA parameters has been done by using simulation tool NS2. If the wake up sensor nodes alone can send the data packet information, then automatically we can save the energy and get high packet delivery ratio. Consequently, the network lifetime gets increases based on their FND and HNA parameters. Table 3 & 4 shows the value for FND of HNA parameters to prolong the network lifetime.

Figure 5 & 6 shows first node dead (FND) parameter as well as alive sensor nodes (HNA) parameter to increase the network lifetime for SLEEP & WAKEUP Technique than FCA

Table 3: Using Fnd Parameter To Increase The Network Lifetime

Algorithm	FND (node dead)	Time
FCA	17,31,36, 73, 59, 31	7.8
SLEEP&WAKEUP Technique	8,10	10

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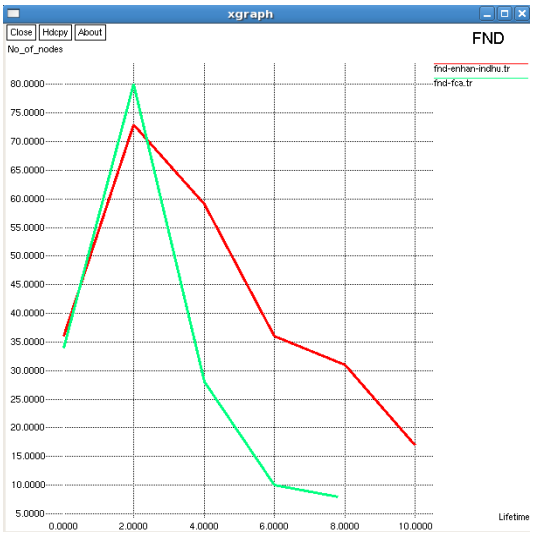

FIGURE 5: FIRST NODE DEAD (FND) PARAMETER FOR FCA AND SLEEP&WAKEUP TECHNIQUE

TABLE 4: USING HNA PARAMETER TO INCREASE THE NETWORK LIFETIME

Algorithm	HNA (alive sensor)	Time
FCA	29, 36, 73	8.3
SLEEP&WAKEUP Technique	8, 10, 28, 79, 34	10

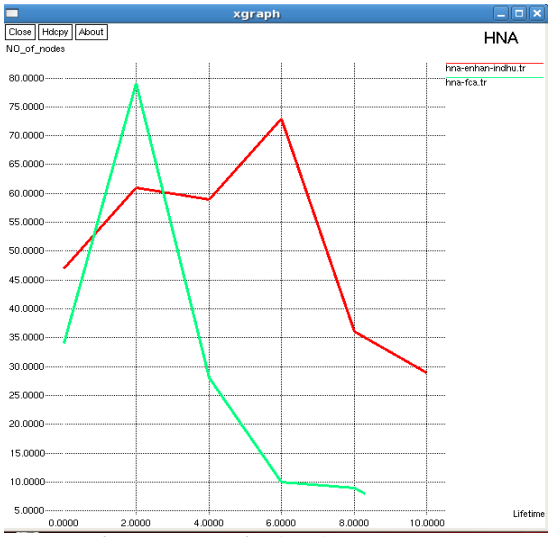

Figure 6: Alive Sensor Nodes (Hna) Parameter For Fca And Sleep & Wakeup Technique.

In simulation results, the sleep & wakeup Approach [17], have many sensor nodes in a network. From these sensor nodes, the C-H has been selected based on their energy as well as base station distance. Consequently, the path [18] has been created from C-H to Base station. If the sensor nodes are in the path, it will become a wake up node has to create a data packet transmission between C-H to BS (base station). Therefore, the energy_spent get decrease and get high PDR in a simulated network algorithm.

Based on time, the energy and PDR value has taken by NS2. In Sleep & Wake up approach, the energy _spent is low as well as the PDR get increase, when compare with FCA. Table 5 & 6 shows the simulation parameter of energy spent & PDR for each algorithm based on time. Figure 7 and 8 shows done the simulation results for energy Spent and PDR.

TABLE 5: SIMULATION PARAMETER ENERGY_SPENT VALUE FOR EACH ALGORITHM BASED ON TIME

Algm/Time	0s	2s	4s	6s	8s	10s
FCA	0	16.75	17.35	17.91	18.48	19.07
S&W	0	0.66	11.22	11.80	12.34	12.91

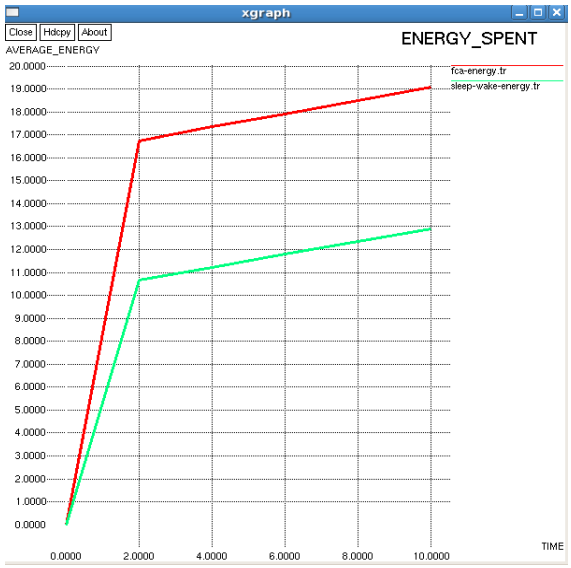

Figure 7: Simulated Results Of Energy_Spent Graph For Each Algorithm Based On Time

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Table 6: Simulation Parameter Pdr Value For Each Algorithm Based On Time

Algm/Time	0s	2s	4s	6s	8s	10s
FCA	0	0.42 50	0.45 68	0.47 93	0.542 4	0.607 5
S&W	0	0.72 17	0.76 16	0.86 54	0.892 5	0.938 5

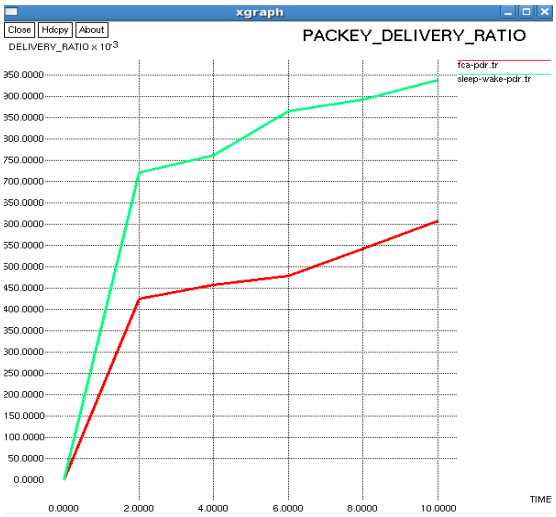

Figure 8: Simulated Results Of Pdr Graph For Each Algorithm Based On Time

4. CONCLUSION

We have presented about the FCA as well as Sleep & Wakeup Technique. Under this work, the FCA has high energy spent and low PDR when compare to that of Sleep & Wake up Technique. Here we have increased the energy efficiency and packet delivery ratio (PDR) along with FND of HNA parameters to extend the network lifetime. However, the energy can be saved up to 63% along with PDR when compared to FCA.

As a future work, the Sleep & Wake up Approach can be extended for Mobile Sensor Network (MSN) like all sensor nodes as a mobile.

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